

Application of Introduced Representatives of *Lonicera pileata* Oliv. in Landscaping of the Right-Bank Forest-Steppe of Ukraine

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How to cite this paper: Varlashchenko, L., Balabak, A., Mamchur, V. and Polishchuk, V. (2021). Application of Introduced Representatives of *Lonicera pileata* Oliv. in Landscaping of the Right-Bank Forest-Steppe of Ukraine. *Grassroots Journal of Natural Resources*, 4(3): 34-41. Doi: <https://doi.org/10.33002/nr2581.6853.040304>

Received: 18 July 2021

Reviewed: 10 August 2021

Provisionally Accepted: 15 August 2021

Revised: 30 August 2021

Finally Accepted: 11 September 2021

Published: 30 September 2021

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Abstract

This article deals with the possibilities to introduce the ornamental shrub *Lonicera pileata* Oliv. belonging to *Caprifoliaceae* Vent. family in the landscaping of the Right-Bank Forest-Steppe of Ukraine. The representatives of *Lonicera pileata* Oliv. (Cultivars *Pileata*, form *Variegata* and form *Lemon Beauty*) endure winter well and adapt to new climatic conditions of the planting site. The plants were found tolerant to shade, cold, pruning, and urban ecological conditions with polluted air. It has been revealed that, depending on the purpose of the landscaping object, these shrubs can perform various functions: create architectural and artistic image of the object; promote biological land reclamation along with other plants; protect against dust and noise; regulate moisture and temperature. Simultaneously, to grow plants of *Lonicera pileata* Oliv. successfully, it is critical to use farming techniques developed by the author scientists. When the representatives of evergreen shrubs of *Lonicera pileata* Oliv. are introduced in the landscaping of residential areas, they can be used to decorate landscape-gardening objects with different functional use creating landscape compositions in gardens and parks, on the plots with different exposition and slopes, as anti-erosion plants, in alpine landscapes, as freestanding shrubs or in group plantations, at the background of lawns, in flowerbeds, in alpine screen gardens, in rockeries, in freely growing and trimmed hedges, and as ground-covering plants.

Keywords

Urban environment; Vegetation period; Farming technique; Decorative effect

Introduction

Enrichment of plant varieties with ornamental plants, especially those that do not require too much care and adapt to extreme factors of changing climate, is an important task of solving current problems while retaining biodiversity, effective use of plant resources and optimization of the state of green space. To improve the structure and decorative effect of garden compositions in urban environment in Ukraine, promising and less common plants belonging to the family *Caprifoliaceae* Vent. are helpful. One popular genus of the family is *Lonicera*. There are over 200 species of *Lonicera* genus (also known as honeysuckle) all over the world, only 30 species became widespread in ornamental gardening, landscaping of residential areas, and landscape design, as described in “Flora of USSR” (Shyshkin, 1958; Karpun, 2004).

All species under *Lonicera* genus can be categorized into three types: upright plants, creepers and climber plants. The upright standing plants are generally the shrubs having fruits not edible, round-shaped, red, purple or orange berries arranged close to leaf axil. *Lonicera pileata* Oliv. is a species belonging to the family *Caprifoliaceae* Vent. In the wild, it is widespread in the mountains of central and western China. At the beginning of the 20th century, it was brought under cultivation. Due to their unusual look, the shrubs became widespread all over Europe, especially in its western part, and later it entered Ukraine, but it got acclimatized only in its southern part of the country (Levon and Kusnietsov, 2001; Hessayon, 2000).

The main usage of evergreen shrub *Lonicera pileata* Oliv. is ornamental decoration of open landscape garden having different functional uses: concealing alpine landscapes, rockeries, creation of alpine screen gardens, small group plantations, free growths and trimmed hedges, and organization of rest areas. However, the value of this shrub *Lonicera pileata* Oliv. lies not only in the decorative uses but also in other functional uses (Kucheriavyyi, 2008). Plants of this species endure winter season very well and adapt to new climate conditions at its site (Laptiev, 2001).

When new plants are introduced in landscape planning, plants adapt successfully and manifest high biological durability. It means that these plants are not affected by late spring and early autumn frosts, and winter frosts or droughts; and plants produce similar seeds that can ensure the availability of planting material for next time. The utility of such plants is in growing and introducing ornamental plants in the landscaping of residential areas in Ukraine. Therefore, the research on *Lonicera pileata* Oliv. is relevant and it generates scientific and practical interest. Hence, the objective of this study is to explore the ecological and biological properties of evergreen ornamental shrubs of *Lonicera* genus having utility in landscaping; to define the regularities of all stages of introduction process; and to perform general analysis of farming practices and care of *Lonicera pileata* Oliv. plantations. This research has been conducted in the experimental plots of the Department of Landscape Gardening of Uman National University of Horticulture, Ukraine. This research has introduced representatives of *Lonicera pileata* Oliv.: *Pileata* variety and *Variegata* and *Lemon Beauty* forms were tested in this study. The scientific novelty of this research is that, for the first time, a less common ornamental plant *Lonicera pileata* Oliv. from the family *Caprifoliaceae* Vent. is introduced in the Right-Bank Forest-Steppe of Ukraine.

Materials and Methods

20 *Lonicera pileata* Oliv. shrubs were selected for the research, including 6 shrubs of form *Variegata*, 6 shrubs of form *Lemon Beauty* and 8 shrubs of cultivar *Pileata*. General scientific analysis, synthesis and observation, and general biological research methods were followed to conduct this research. During the experiment, observation was carried out over the period from 2017 to 2020 on the experimental plot at the Department of Landscape Gardening, Uman National University of Horticulture. This methodology of phenological observations was developed for botanical gardens to study the vegetation in the botanical gardens of the USSR (1975). The selection of trees and shrubs for introducing the plants was based on the methods developed by (Kochno and Kuznietsov, 2005). During the research on the growing of *Lonicera*

pileata Oliv., some farming techniques were developed based on the experiences of the scientists in this field (Varlashchenko, 2016; Hessayon, 2000).

A group of 20 young plants having 3-year age was performed in autumn of 2017 in the area of 144 m², taking into account the fact that, in spring, the buds swell very quickly and, as a result, they do not survive longer. The holes under young plants were prepared beforehand at the distance of 2 x 2 m, with the diameter of 40 x 40 cm, followed by the holes were filled with soil rich in nutrients in a cone-like manner. The upper layer of the soil was mixed up with a bucket of manure. A young plant was put into a hole, the roots were spread and covered with a thin layer of earth. The soil was compacted and well-watered. Sawdust was used as mulch. After the planting, young plants were trained only during the second year by cutting off sick and damaged shoots.

The first fertilization was performed 2 years after planting in early spring. 25-30 g of ammonium nitrate was put under every shrub. In summer month of July, the plants were fertilized with manure: one bucket of compost per 1 m²; whereas in autumn, 1-2 glasses of ash and 30 g of superphosphate. During sanitation pruning, the damaged and sick shoots were cut off. Regenerative pruning was performed only after 5 years.



Photo 1: The *Pileata* variety

During the research on *Lonicera pileata* Oliv., ecological and biological properties of both introduced forms *Lonicera pileata Variegata* and *Lemon Beauty* and cultivar *Pileata* for landscaping were studied, stages of introduction process in the changed climate conditions were analyzed, farming techniques and treatment of plantations were suggested.

Results and Discussion

The analysis has shown that, among green vegetation of Uman National University of Horticulture, a considerable percentage consists of ornamental trees and leafy shrubs, while evergreen plants are not common in the landscaping of this territory. In 2017, 20 shrubs of *Lonicera pileata* Oliv. were planted on the site of the experimental plot: 8 *Pileata* cultivars, 6 of Variegata form and 6 of Lemon Beauty form of the shrub. Ecological and biological features of the shrubs were studied during the research period (2017-2020). *Lonicera pileata* Oliv. cultivar *Pileata* is one of the rare varieties of the ornamental plants having upright honeysuckle features. Originated in Japan, it is a low, evergreen or semi-evergreen wide-branched shrub that grows to the height of 0.4-1.0 m. The leaves are small, 0.5-2 cm long, ovate, lance-shaped with wedge-shaped basis, glossy, dark green on the surface and pale green on the reverse side, lightly hairy, and arranged in pairs on the stems of short petioles. Fragrant flowers are arranged in pairs on upright flower stalks having 0.5 cm length. Bilabiate corolla is tubular and cone-shaped, white with red coating, 0.8 cm long, hairy on the outside or almost bare. Stamens and pistils are hairy and longer than corolla. Floral bracts are awl-shaped, almost of the same length as ovary. Fruits are translucent, round-shaped berries, 0.5 cm across, of amethyst or purple and velvet coloring. It blossoms in May–June and bears fruits in October. The plant grows slowly, endures shade well, and reproduces vegetatively (Varlashchenko and Balabak, 2021; Kohno and Kurdyuk, 1994). It looks attractive in solitary and in group plantations.

Lonicera pileata Oliv. variegated form (*Lonicera pileata* Variegata) is evergreen dwarf shrub, 20 cm high with small 1-2 cm long lance-shaped leaves, dark-green, glossy, opposite leaves, similar to boxwood leaves (that quickly grow after cutting). If watered regularly, the shrub grows high; otherwise, it remains dwarf and ground covering. It blossoms in the middle of May–June and produces beautiful fragrant white flowers. Berries are elongated, 6 mm across, translucent, red or light blue-purple, early ripening (September–October), and not edible. It reproduces by suckers, layers and grafts (Varlashchenko and Balabak, 2021; Karpun, 2004).

In landscape design, *Lonicera pileata* Variegata looks nice and attractive in different compositions and is the best alternative to boxwood (*Buxus sempervires* L.). It grows quickly, endures easily the pruning and training, grows well in the sun and in partial shadow, and is drought and cold resistant. The plant needs covering during frosty winters without snow. It is planted in rockeries, shrub groups, and among coniferous plantings (as a groundcover plant).

Lonicera pileata Oliv., form *Lemon Beauty* (shining honeysuckle), originates from Western China, and grows in mountainous areas of provinces Sichuan and Yunnan. It has been in cultivation since 2008. It is evergreen shrub in southern areas and semi-evergreen with partially deciduous leaves in northern areas. The shrub may grow up to 1.2 m height and spread its dome-like crown up to 1.5 m in diameter. Stems are covered with smooth scaled bark; shoots are thin, light brown with olive-green tint. Leaves are small, oval, egg-shaped, glossy, light green with white edging (Varlashchenko and Balabak, 2021; Sikura and Kapustyan, 2003).

The complicated characters of introduced plant were observed. The process of introducing a plant can be roughly divided into three successive stages: the selection of plant to be introduced, testing of the plant, and introduction of plant in the cultivation process (Laptiev, 2001). It is an important observation that there is a difference in the phenological stages among different representatives of *Lonicera pileata* Oliv. genus during the process of phylogenies. The absence of blossoms in the first year of growing the cultivar *Pileata*, form *Variegata*, and form *Lemon Beauty* reduces the acclimatization feature of the introduced plants, though it is not a crucial feature for determining the potential of the plants. This fact is caused by insufficient sun-exposure of the habitat, physiological and ecological hardiness of the plants under conditions of the research (Lapin, 2019).

Duration indices of vegetation period of the representatives of *Lonicera pileata* Oliv. in the town of Uman are presented in table 1.

Table 1: Duration indices of vegetation period of the representatives of *Lonicera pileata* Oliv. in the Right-Bank Forest-Steppe of Ukraine

<i>Nº</i>	<i>Cultivar, forms</i>	<i>Duration of Vegetation Period (days)</i>
1.	Pileata	196±15
2.	Variegata	190±10
3.	Lemon Beauty	194±12

The duration indices of the vegetation period show that all the investigated representatives of *Lonicera* genus are suitable for growing and arranging compositions in the town of Uman. It is worth mentioning that given shrubs undergo all phenological stages of development when introduced in the Right-Bank Forest-Steppe of Ukraine and are characterized by the starting and final dates of flowering, stems growth, blossoming, fruiting and ripening of fruits, etc. (Table 2).

Table 2: Phenological stages of growth and development of *Lonicera pileata* Oliv. in the Right-Bank Forest-Steppe of Ukraine (from 2017 to 2020)

<i>Nº</i>	<i>Cultivar, forms</i>	<i>Dates of phonological stages of development</i>			<i>Duration of blossoming (Days)</i>
		<i>Buds swelling</i>	<i>Buds breaking</i>	<i>Leaves unfolding</i>	
1.	<i>Pileata</i>	16.03–25.03	31.03–21.04	18.04–20.05	18.05–18.06
2.	<i>Variegata</i>	12.03–21.03	25.03–17.04	14.04–17.05	15.05–19.06
3.	<i>Lemon Beauty</i>	14.0 –24.03	28.03 – 20.04	15.04–18.05	16.05–17.06

On an average, the vegetation period of *Lonicera pileata* Oliv. representative during the research was 205.6 days. Form *Lonicera pileata* Variegata was recorded to have the shortest duration of vegetation period, while cultivar *Pileata* had the longest period. Bud swelling and bud breaking are regarded to be the beginning of the vegetation - trees or shrubs. Phenological observations over honeysuckle cultivar have shown that breaking of reproductive buds takes place at an average daily temperature +7...10°C with sum of effective temperatures 12...20°C (Table 2). Over the period of research, this stage took place in the second half of March. The breaking of reproductive buds was not simultaneous: the buds on the lower shoots opened earlier than those on the upper shoots.

In years having long winter thaws, lower reproductive buds that received more warmth from the soil surface swelled and began to break. Under further fall of temperature, their development ceased, and they successfully endured the fall of temperature. The breaking of flower buds depended on weather conditions and lasted from 12 to 25 days. Flower-bud formation began when the sum of effective temperatures was 70–90°C in the first half of April (Table 2). The duration of this phase depended on the temperature that lasted 12–18 days.

The findings of the research have shown that in the Right-Bank Forest-Steppe of Ukraine the blossoming of the representatives of *Lonicera pileata* Oliv., on an average, began on 15th–18th of May under the average daily temperature 12-14°C and on sum of effective temperatures 170°C. The duration of blossoming lasted 30–33 days and depended, to the great extent, on the atmospheric temperature and humidity. Linear growth of shoots began during massive blossoming and finished in dry years (2019, 2020) in the second half of July, and under sufficient moistening (2018), at the beginning of August. It has been established that the deviation of some dates of certain stages over the years of research depends on the climate and weather indices of a particular year. The difference in the starting dates of certain phenological stages of all shrubs

depended on the time of blossoming, from 15th – 18th of May to 16th – 18th of June and complete ripening of berries from 16th of September to 15th of October.

Winter hardiness of shrubs was determined visually, after analyzing the state of plants during and after the winter. Frequent thaws caused damage to shrubs, resulting in freezing of shoots in 2019 and 2020. The observations were generalized over three years, taking into account the character of freezing. It turned out that one and the same representative in different years had different winter resistance. It is worth mentioning that some shrubs froze under -23°C frost when there was no snow, but under considerable snow covering frosts did not cause considerable damage to shrubs. In general, all introduced representatives of *Lonicera pileata* Oliv. have a good level of acclimatization and they can be recommended for the introduction in the landscaping of the Right-Bank Forest-Steppe of Ukraine.

Conclusions

The representatives of *Lonicera pileata* Oliv. have hard and inflexible stems sprawling on earth and easily take roots when touching the soil. The pest and diseases rarely afflict the plants, but during cold and wet summer, fungal infection may appear, such as powdery mildew, rust. Very often, juicy shoots can be attacked by aphids (*Aphidoidea*), leaf moth (*Cameraria ohridella*) and red spiders (*Purpuratus apterus*). To fight diseases, it is necessary to use systemic fungicides: Vectra, Topaz, and Hamiar. Inta-Vira, Akhtar and Aktelika were used to fight pest. All plants grow well both in the sun and shade, on the sites protected against wind, and on drained loamy soils with neutral pH. Performance of all farming techniques applied to grow *Lonicera pileata* Oliv. ensures excellent decorative effect and durability of plantings. So, according to ecological and biological features, the representatives of *Lonicera pileata* Oliv. can be grown as decorative plants that are able to emphasize the uniqueness of a garden or a household plot. Dwarf shrubs can be used in both landscape and panoramic compositions. Thick and dense crown of shrubs give any relief a beautiful and noble look. However, to select introduced representatives of *Lonicera pileata* Oliv., *Pileata* cultivar, *Variegata* form and shining honeysuckle form *Lemon Beauty*, it is necessary to take into account their ornamental properties.

Introduced cultivars of *Lonicera pileata* Oliv., cultivars *Pileata*, *Variegata* and *Lemon Beauty*, were researched. It has been established that their ecological and biological variable indices of decorative effect (of shoots, leaves, crown shapes, flowers, and fruits) and resistance to environmental factors make their use in the landscaping in the Right-Bank Forest-Steppe of Ukraine justifiable and suitable for introduction. Performance of all farming techniques used to grow and care the evergreen shrubs of *Lonicera pileata* Oliv. will provide with high decorative effect and improve their durability in the plantings having various combinations: in flowerbeds, hedges, rockeries, alpine screen gardens, etc.

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Authors' Declarations and Essential Ethical Compliances

Authors' Contributions (in accordance with ICMJE criteria for authorship)

Contribution	Author 1	Author 2	Author 3	Author 4
Conceived and designed the research or analysis	Yes	Yes	Yes	Yes
Collected the data	Yes	No	No	No
Contributed to data analysis & interpretation	Yes	Yes	Yes	Yes
Wrote the article/paper	Yes	Yes	Yes	Yes
Critical revision of the article/paper	Yes	Yes	Yes	Yes
Editing of the article/paper	Yes	Yes	Yes	Yes
Supervision	No	Yes	No	No
Project Administration	Yes	Yes	Yes	Yes
Funding Acquisition	Yes	Yes	Yes	Yes
Overall Contribution Proportion (%)	40	30	15	15

Funding

No funding was available for the research conducted for and writing of this paper.

Research involving human bodies (Helsinki Declaration)

Has this research used human subjects for experimentation? No

Research involving animals (ARRIVE Checklist)

Has this research involved animal subjects for experimentation? No

Research involving Plants

During the research, the authors followed the principles of the Convention on Biological Diversity and the Convention on the Trade in Endangered Species of Wild Fauna and Flora.

Research on Indigenous Peoples and/or Traditional Knowledge

Has this research involved Indigenous Peoples as participants or respondents? No

(Optional) PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses)

Have authors complied with PRISMA standards? No

Competing Interests/Conflict of Interest

Authors have no competing financial, professional, or personal interests from other parties or in publishing this manuscript.

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